

NASA International Environmental Partnerships

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This brochure describes NASA efforts with international partners on environmental projects and the value they add.

For nearly five decades, the National Aeronautics and Space Administration (NASA) has been pre-eminent in space exploration. NASA has landed Americans on the moon, robotic rovers on Mars, and led cooperative scientific endeavors among nations aboard the International Space Station. But as Earth's population increases, the environment is subject to increasing challenges and requires more efficient use of resources. International partnerships give NASA the opportunity to share its scientific and engineering expertise. They also enable NASA to stay aware of continually changing international environmental regulations and global markets for materials that NASA uses to accomplish its mission. Through international partnerships, NASA and this nation have taken the opportunity to look globally for solutions to challenges we face here on Earth.

Working with other nations provides NASA with collaborative opportunities with the global science/engineering community to explore ways in which to protect our natural resources, conserve energy, reduce the use of hazardous materials in space and earthly applications, and reduce greenhouse gases that potentially affect all of Earth's inhabitants. NASA is working with an ever-expanding list of international partners including the European Union, the European Space Agency and, especially, the nation of Portugal. Our common goal is to foster a sustainable future in which partners continue to explore the universe while protecting our home planet's resources for future generations. This brochure highlights past, current, and future initiatives in several important areas of international collaboration that can bring environmental, economic, and other benefits to NASA and the wider international space community.



This photo shows some of the participants from an international workshop and partners with whom NASA has developed relationships. From Left to Right: the Mayor of Peniche, Portugal; the President of the School for Tourism and Maritime Technology, Peniche; the NASA Assistant Administrator for Infrastructure; the United States Ambassador to Portugal; and the President of the Portuguese Center for Pollution Prevention

Benefits of International Partnerships

- Sharing scientific and engineering expertise
- Awareness of continually changing international environmental regulations
- Understanding global material markets and their impacts to mission

Materials Management and Substitution

Materials management focuses on the selection of materials that meet performance requirements while minimizing potential risks such as obsolescence and other impacts from regulatory restrictions. Materials management reduces the risk to space missions and can result in numerous benefits including protection of the environment, improved health of workers, enhanced processes, and reduced costs.

As environmental regulations in the United State (U.S.) and worldwide become more stringent, materials that have traditionally been relied upon for many applications may no longer be available. One such material is hexavalent chromium used in coatings for corrosion protection. Increased awareness of the hazardous properties of hexavalent chromium and the risks to human health and the environment has led to increasing regulation. Many manufacturers have stopped producing hexavalent chromium-containing products rather than comply with more demanding requirements. This potential material obsolescence requires users to seek viable substitutes.

In response, NASA, the European Space Agency, and aerospace companies have been seeking alternative coating systems that are able to meet the rigorous performance requirements of aerospace applications. In 2004, in one of its first international environmental collaborative efforts, NASA teamed with the Centro Para Prevenção da Poluição (Portuguese Center for Pollution Prevention) and two Portuguese entities, TAP Portugal (the Portuguese National Airline) and OGMA Indústria Aeronáutica de Portugal (the Portuguese Aeronautics Industry) to identify and test aircraft coating systems that offered many benefits, including reduced use of hexavalent chromium. The project was primarily funded by the Portuguese partners while NASA funded some laboratory testing and provided project management expertise.

One system satisfactorily passed all laboratory tests and after nearly three years of in-flight testing, the alternative coating system showed no signs of deterioration. The success of this collaborative project has led to interest in other joint international efforts that allow stakeholders to engage experts from around the world while sharing the burden of testing costs, ensuring the safety of workers, and reducing environmentally driven risks. The potential use of any qualified alternative resulting from partnership testing benefits NASA, the European Space Agency, defense agencies, and airlines by decreasing obsolescence risks for aircraft, spacecraft, rockets, and satellites.

There are many mutual challenges faced by aerospace agencies and industries around the world, and collaboration between NASA and international partners results in benefits to all involved by sharing resources and bringing the experts of the world together to meet common goals.

Lead-free Electronics

Recent European Union regulations have caused commercial suppliers worldwide to shift from the use of lead in standard electrical products. Concerns have arisen about whether traditional lead-containing electrical components and solders will still be available for aerospace and military electronics applications and subsequently, how reliable lead-free electronics may be in spacecraft, satellites, and aircraft that operate in extreme conditions.

An initial NASA-led project showed that lead-free parts could be less reliable. A follow-on effort with stakeholders from the U.S., Canada, Japan, and Europe is further assessing how new solder and finish alloys will affect the performance of electronics. The high degree of international participation reflects the

prominence of this issue in the global aerospace and military industries and provides opportunities for shared expertise and knowledge.



Lab technician holding a test board consisting of lead-free electrical components and solder

Sustainable Development

NASA is committed to a policy of sustainability to execute its mission without compromising our planet's resources. In implementing sustainability practices, NASA manages risks to the mission, the environment, and our communities. For many years NASA has been on the path to achieve long-term sustainability goals through numerous efforts in energy conservation, recycling, efficient design and construction, water management, and materials management, among others. In this manner, NASA seeks to better utilize the resources of our home planet and to work collaboratively with others here in the U.S. and around the world. Both national and international partnerships and collaboration have been an important part of NASA's efforts.

NASA actively participates in domestic interagency groups. These include the Department of Defense, the Department of Energy, the Environmental Protection Agency, U.S. Global Change Science Program Office, the Government Accountability Office and the Council on Environmental Quality. Participants share data, approaches, scenarios, and expertise on areas of mutual concern regarding sustainability. Working with other agencies and, increasingly, with the international community, benefits NASA and its partners by sharing lessons learned and best practices. Synergies that optimize the use of scarce resources and enhance the mission are frequently discovered through coordination and communication between participating agencies and communities.

NASA's experience and knowledge in working with renewable energy and high efficiency technologies has a number of international implications. One such example is the agreement NASA has signed with Portugal to work together on the Sustainable Energy and Construction (ECOS) Project. The aim of ECOS is to create competitive and innovative cities at an international level. NASA and Portugal's Centro Para

Prevenção da Poluição (Portuguese Center for Pollution Prevention, or C3P) will evaluate and document technologies and best practices for reducing the environmental impact of buildings over their entire lifetimes, while optimizing the buildings' economic viability as well as the comfort and safety of those who live and work in them.



Solar panels at Santa Cruz Public High School, Torres Vedras, Portugal

Both NASA and C3P will benefit from sharing technical information on new technologies and designs for individual buildings and groups of facilities in several municipalities. Perfecting the design of sustainable buildings on Earth will help engineers develop sustainable habitats for use in other locations across the solar system.

While we still have yet to design the perfect self-sustaining system for exploration, our experiences and goals in space are powerful reminders about why these systems are critical for life here on Earth. As NASA continues to aim for the stars and unravel the complex science that directs our planet's processes, we are proceeding in a manner that preserves, enhances, and strengthens our ability to perform our mission while providing for the needs of future generations on Earth.

Berlenga Island – Reducing a Carbon Footprint and Increasing Sustainability

NASA and Portugal are working together on a pilot project to reduce the carbon footprint and environmental presence of Berlenga Island, an island off the coast of Portugal used for fishing, recreation and culture. Goals for the project include renewable energy to provide a sustainable means of providing a power supply and a source of drinking water and wastewater treatment for an island that must meet the requirements of more than 90,000 visitors each summer.



Berlenga Island

Information Sharing

NASA encourages collaborative efforts with industry, academia, and government agencies, both domestically and internationally. Through these partnerships, common risks to missions undertaken by NASA and its partners can be reduced. NASA encourages teamwork through specific projects, and, also importantly, through sharing information on common problems, experiences, and solutions.

For the past eight years, NASA and Portugal's Centro Para Prevenção da Poluição (Portuguese Center for Pollution Prevention or C3P) have hosted an annual international workshop that showcases innovative and emerging environmental and energy technologies. The workshop provides a unique opportunity for the diverse group of participants to share lessons learned and identify new opportunities for collaboration. In addition to the wide breadth of topics covered in formal presentations, participants are able to explore and exchange knowledge and experiences they have gained.

The international workshops also provide the opportunity to raise awareness of and interest in space, energy, and environmental challenges among students. University students from both the U.S. and abroad have attended the workshops, presenting their work in identified technical areas. Projects presented cover several areas of interest to the workshop participants and can lead to research initiatives, or further development of the project. Topics have included advances in solar energy technologies, analysis of solar power efficiency, and wind turbine design.



Student participants from the 2009 C3P/NASA International Workshop

An increasingly important area of global interest and collaboration involves Encroachment Risk Mitigation. Encroachment is the cumulative impact of pressures placed on an agency's infrastructure and the surrounding communities, resulting from factors such as increases in development and urbanization near government facilities and competition for resources. These pressures result in increased mission costs and schedule disruptions, and pose challenges to performance requirements.

NASA has also hosted multiple meetings and teleconferences with U.S. and European defense agencies, private industry, and the European Space Agency to address the challenges of encroachment. Discussions have included topics such as climate change impacts and energy management. Identifying and understanding risks related to encroachment are key to implementing procedures that manage these risks and ensure continued mission success. These examples of international – even intergenerational – collaboration will also help ensure the sustainable future that is the common goal of all participants.

Other Opportunities on the Horizon

In addition to the initiatives described above, there are several other areas in which NASA is looking to work with others in the domestic and international communities. The challenges are many, but so are the opportunities, as NASA and its international partners seek to attain the goals of exploration in space and a better quality of life and a sustainable future here on Earth.

Together, NASA, the European Space Agency, Portugal, and other nations are working to reduce our environmental footprint while learning more about both the universe and our home planet. Here are few examples of what is on the horizon.

- *Hydrazine Fuel Waste Reduction:* Hydrazine rocket fuels are extremely hazardous and very expensive to dispose of. A joint effort is planned to reduce, reuse, or eliminate these waste fuels.
- *Helium Reuse:* NASA and ESA use helium in a variety of applications, but a current worldwide shortage of helium has led to much higher prices. A planned project would look at ways to capture helium currently lost to the atmosphere from ground propellant operations. Helium is used as a medium to displace fuel and oxidizers in storage tanks, and to purge fuel from ground support equipment prior to launch. The benefits of such a project would be conservation of an extremely limited critical resource.
- *Materials Testing:* Performance testing is a crucial component of materials management and selection. The Kennedy Space Center Corrosion Technology Laboratory and Guiana Space Centre (France and the European Space Agency's main spaceport) are planning a partnership to share corrosion testing data.

- *Green Sustainable Design:* NASA is in the process of incorporating green sustainable design into NASA infrastructure, the buildings and facilities used for all aspects of our programs. One plan is to create a “green roof” test bed using lessons learned from green roofs in Germany. A green roof serves several purposes for a building, such as absorbing rainwater, providing insulation, creating a habitat for wildlife, reducing noise, and combating the urban heat island effect (the phenomenon in which urban areas are significantly warmer than surrounding rural areas because of heat retention from urban development).

Continuing the Mission...

The idea of international collaboration is not new, but the drive to better utilize and preserve the resources of the Earth – and utilize those of the world’s science and engineering community – has never been greater. President John F. Kennedy famously said “We all breathe the same air...We all cherish our children’s future.” Today, the international community seeks better ways to protect the air we all breathe and the water we all drink. NASA and its partners are also seeking new sources of renewable energy – to meet the needs of future generations. The international collaboration that is at the heart of NASA’s partnerships will help to accomplish the missions of the present and foster a more sustainable future to reduce risks to the missions that lie ahead.

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